

Evaluation of Kahuku Whole Plant Sugarcane Greenchop as a Ruminant Feedstuff

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Whole sugarcane plant has been used as a cattle feed since sugarcane was first grown (Kirk, Peacock and Davis, 1962). The whole plant has been fed effectively as an ensilage (Shealy, Kirk and Crown, 1941) and has been cut in Florida as a feed for growing and fattening beef animals (Kirk and Crown, 1942). The nutritive value of sugarcane grown in Hawaii has also been determined, using sheep digestion trials (Sherrod, Ishizaki and Cobb, 1968).

Recent research has been directed toward the use of sugarcane waste products. Few data are available on the use of chopped whole Oahu sugarcane plant as a fodder, and no data are available on the value of abandoned cane as a livestock feed in Hawaii.

Sugarcane abandoned since the closing of the mill at Kahuku in early 1972 is currently being chopped and marketed as greenchop by Lowe, Inc. The object of this investigation was to provide information on the relative feeding value of Kahuku chopped whole sugarcane that was left untended for approximately 1 year.

Experimental Procedure

Random grab samples of freshly chopped sugarcane were obtained from Kahuku on six different days during the last 2 weeks of February 1973.

Dry matter was determined on subsamples of the wet chopped cane by Association of Official Analytical Chemists (AOAC) method, 1970. The remaining portions of the samples were dried in a forced-air oven for 1 week at 50 C. After drying, each sample was ground through a 40-mesh screen in a Thomas-Wiley Mill before analyses.

Crude protein, ether extract and ash were determined on each sample as outlined in AOAC, 1970. Each sample was also analyzed for neutral detergent fiber (Van Soest and Wine, 1967), acid detergent fiber and lignin (Van Soest, 1963).

Digestibility was determined by the *in vitro* artificial rumen method of Mellenberger et al., 1970, with some modifications by Olbrich (unpublished).

Results and Discussion

Mean values, plus ranges, for the chemical analyses and *in vitro* digestibility are shown in Table 1. Chemical analyses and *in vitro* dry-matter digestibility of a random sample of pineapple greenchop are included for comparison, as well as the mean proximate analysis values for pineapple plant, compiled by the Department of Animal Sciences, University of Hawaii.

The mean dry matter of the chopped cane was 28.9 percent. This is approximately one-half more dry matter on a fresh basis than is found in 18 to 20 percent dry-matter pineapple greenchop.

The fiber levels for both pineapple greenchop and chopped sugarcane were relatively high. The recently developed detergent fiber techniques were used to determine the different fibrous components.

The neutral detergent fiber procedure is a method for analyzing the total fiber in a feedstuff. The neutral detergent fiber portion represents the cell-wall constituents of the plant and contains lignin, cellulose, hemicellulose and some fiber-bound protein. That part of the sample not appearing as residue or neutral detergent fiber is termed neutral detergent solubles or cell contents. This portion is very readily digestible (95+ percent), while the neutral deter-

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Table 1. Chemical composition and dry-matter digestibility of whole-plant sugarcane greenchop

Sample	Percent dry matter	Chemical composition—percentage on dry-matter basis						Digestibility percent on dry-matter basis ³
		Neutral detergent fiber	Acid detergent fiber	Acid detergent lignin	Crude protein	Ash	Ether extract (fat)	
Whole plant, chopped sugarcane	28.9	67.9	39.9	5.7	4.1	8.7	1.2	56.5
Range—high low	31.5	70.1	41.9	6.2	5.6	14.2	1.5	68.7
	27.2	60.9	37.6	5.2	2.4	6.0	0.8	49.6
Chopped pineapple plant ¹	18.3	63.7	35.9	6.3	7.6	6.4	2.2	62.6
Pineapple plant ²	20.6	N/A	N/A	N/A	9.2	1.5	4.9	73.3 ⁴

¹Random sample of pineapple greenchop obtained the same time as chopped sugarcane.

²From: Composition of feedstuffs/energy feeds, compiled by Department of Animal Sciences, University of Hawaii.

³Artificial rumen analyses, Mellenberger et al., 1970. Alfalfa control had dry-matter digestibility of 62.2 percent.

⁴Calculated from average TDN data.

N/A = not available.

gent fiber is only partially available and depends on microbial fermentation in the rumen for use by the animal. Neutral detergent fiber in the chopped cane was 67.9 percent, and in pineapple greenchop it was 63.7 percent. Based solely on these values, one would expect pineapple greenchop to be a little more digestible than the chopped sugarcane from Kahuku.

The major constituents of acid detergent fiber are cellulose and lignin. This portion was also slightly higher in chopped cane (39.9 percent) than in pineapple plant (35.9 percent). The cellulose portion of the plant cell wall is composed of chains (carbon 1 of one molecule joined to carbon 4 of another) of glucose (simple sugar) molecules in beta linkages. Purified cellulose is highly digestible by rumen microorganisms. Cellulose as it occurs in the plant cell wall, however, is often only partially available for rumen microbial attack and digestion. The relative digestibility of cellulose is greatly dependent on the nature of its physical and chemical association with lignin. Lignin is a complex polymer of aromatic alcohols found in the cell walls of all woody plants. The exact chemical configuration of lignin, as well as the actual nature of its bonding relationship to cellulose, has not yet been definitively determined. Because of its complex chemical nature, lignin is not available to rumen microorganisms as a nutrient material. The presence of lignin also greatly decreases the effectiveness of microbial enzyme breakdown of the other plant cell-wall

components. Generally, the higher the lignin content of a plant, the lower the digestibility of the cellulose. Lignin apparently acts as a physical-chemical barrier between bacterial cellulase enzymes and cellulose.

Lignin values for chopped cane and pineapple greenchop were nearly identical (approximately 6 percent). Sugarcane trash (or cane strippings), which is much less digestible (20–43 percent), has close to 10 percent lignin, while bagasse has 11 to 12 percent lignin and generally an even lower dry-matter digestibility.

The protein value for the sugarcane plant was relatively low, with daily variation from 2.4 to 5.6 percent. This is less than the 7.6 percent protein value for pineapple plant.

The 56.5 percent dry-matter digestibility of the chopped cane was fairly high. This value was slightly lower than the 62.2 percent digestibility of the alfalfa control. Dry-matter digestibility of the chopped cane in this study was essentially the same as reported by Sherrod et al., 1968, who found an organic dry-matter digestibility of 51.1 to 56.2 percent for cane from the Hamakua area. The calculated digestible dry matter for pineapple greenchop, based on previous data, was 73 percent. This was higher than that of either alfalfa or sugarcane plant. However, the digestibility for pineapple greenchop in the present study was only 62.6 percent, which was nearly identical to the alfalfa control and only slightly higher than the cane.

Conclusion

Although chopped sugarcane may have a slightly lower digestibility than pineapple greenchop, sugarcane contains considerably more dry matter on a fresh-chopped basis. Based on the results of this study, it can be concluded that chopped whole sugarcane plant from Kahuku is a fairly high quality fodder and should be at least equal to pineapple greenchop on a fresh-chopped basis.

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